REMARKS/ARGUMENTS

Claims 1, 3-42, 51 and 52 remain in this application. New claim 53 has been added. Claims 2 and 43-50 have been canceled.

Claim 1 has been amended to include the limitation of claim 2, viz, that the sample channel has a curved portion to deliver fluid to an isolated sensing area. Moreover, claim 1 has been amended to show that the flow cell comprises a substrate having at least one sample channel <u>integral with</u> at least one optical fiber channel holder. Each sample channel has a curved portion to deliver fluid to an isolated sensing area. Each optical fiber channel holder has an optical fiber disposed therein, wherein each optical fiber has at least one grating and wherein each optical fiber is precisely aligned and tensioned in a straight line within each optical fiber channel holder. The isolated sensing area is defined as an area where each optical fiber grating is proximate to the curved portion of each sample channel. Lastly, at least one sample port is positioned in an operable relationship to at least one sample channel. Support for this amendment is found in Figures 1, 2A and 2B, 3, 4, and 5-11B and paragraphs [0034] – [0037] specifically.

Claim 38 has been amended to correct a typographical error.

Claims 51 and 52 have been amended to claim a flow cell kit comprising an upper substrate having at least one curved sample channel for delivering a sample to an isolated sensing area and at least one sample port disposed therein. At least one optical fiber channel holder having an optical fiber disposed therein wherein each optical fiber has at least one grating disposed therein wherein each optical fiber is precisely aligned and tensioned in a straight line within each optical fiber channel holder. The optical fiber channel holder has a means to connect to the upper substrate to form a unit wherein the isolated sensing area is defined as an area where the grating is proximate to the curved portion of the sample channel and a lower substrate having a means to connect to the optical fiber channel holder on a side opposite from the upper substrate. Moreover, claim 52 is directed toward having the ability to form an array. Support for these claims is

found in Figures 2A, 2B, 3, 10, 11A and 11B and paragraphs [0039], [0040], [0043], and [0044].

Claim 53 has been added to claim a configuration of the flow cell comprising three mating pieces. Support for this claim is found in Figure 3 and paragraph [0040].

Claims 1,3, 4, 37 and 39 stand as rejected under 35 USC §102(b) as being anticipated by Crotts et al. (US Patent 6,215,943 B1). The Examiner asserts that "Regarding claim 1, Crotts et al. disclose an apparatus comprising: an optical fiber with a grating (see column 4, lines 40 and 44, Bragg grating or long period grating), a tube (20, optical fiber channel holder) and an aperture (50, sample channel & port). The tube is a monolithic structure (see column 3, line 55) and a cylindrical shape (see Fig. 4)."

Applicants respectfully disagree. Claim 1 has been amended to claim the invention as having several key distinctions from that of Crotts et al. (Claims 3, 4, 37 and 39 are dependent on claim 1 and therefore, incorporate all the limitations of claim 1.) In particular, the flow cell comprises a substrate having at least one sample channel <u>integral with</u> at least one optical fiber channel holder. Each sample channel has a <u>curved</u> portion to deliver fluid to an isolated sensing area. Hence, the presently claimed invention requires both a substrate having a sample channel and an optical fiber channel holder. The two elements are integral with one another to form the flow cell unit. In addition, the curved portion of the sample channel delivers fluid to an isolated sensing area. The teaching of Crotts et al. fails to anticipate the presently claimed invention for several reasons. First, Crotts et al. fail to disclose a separate substrate having a sample channel wherein the sample channel has a curved portion to deliver fluid to an isolated sensing area. Rather, Crotts et al. disclose, "an optical fiber holder comprising a tube having a longitudinal axis…An aperture is disposed along a length of the longitudinal axis of the tube. The aperture allows for exposure of the optical fiber to a sample." (Col. 2, lines 43-49) More specifically, "The optical fiber holder is inserted into a vessel containing a sample and the sample is circulated past the sensing element." (Col. 2, lines 59-62). By the present invention, the curved configuration of the sample channel allows for delivery

of the fluid to an isolated sensing area (Claim 1) so there is no need to insert the optical fiber holder into a vessel containing a sample. Secondly, Crotts et al. fail to disclose at least one sample port positioned in an operable relationship to at least one sample channel (claim 1). In fact, the invention of Crotts et al. has no sample port and no sample channel. Rather, "the optical holder comprises a tube having a longitudinal axis…An aperture is disposed along a length of the longitudinal axis of the tube. The aperture allows for exposure of the optical fiber to a sample." (Col. 2, lines 43-49) More specifically, "The optical fiber holder is inserted into a vessel containing a sample and the sample is circulated past the sensing element." (Col. 2, lines 59-62). Therefore, the teaching of Crotts et al. fails to anticipate applicants' claimed invention because there is no curved sample channel and no sample port. In addition, Crotts et al. fail to disclose that each sample channel has a <u>curved</u> portion to deliver fluid to an isolated sensing area (claim 1). Therefore, the rejection is without basis and should be withdrawn.

Claims 1, 3-42, 51 and 52 stand as rejected under 35 USC §103(a) as being unpatentable over Pauluth et al. (US Patent 6,137,576) and further in view of Murphy et al. (US Patent 5,864,641).

The Examiner states, "Regarding claims 1, 8 and 36, Pauluth et al. disclose the claimed invention (see Fig. 1 and Fig. 7) including a reflection grating coupler equipped in a flow cell (29) with an inlet (30) and an outlet (31). However, Pauluth et al. teach a planar waveguide but do not teach using an optical fiber. Murphy et al. teach an optical waveguide sensor having a grating and a reactive coating and exposing the sensing area to a sample. Murphy et al. further teach that the optical waveguide is either a planar optical waveguide, an integrated optic waveguide or a fiber optic waveguide (see column 7, lines 50-53). Pauluth et al. teach using an optical waveguide for sensing region that is further coupled to an optical fiber (see Fig. 1). Thus, using an optical fiber in Pauluth et al. as taught by Murphy et al. would have been an obvious design choice to one having ordinary skill in the art at the time the invention was made and also using an optical fiber in the sensing region would not require coupling of the waveguide and the optical fiber

thus providing improved coupling efficiency. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use an optical fiber in Pauluth et al. to improve coupling efficiency. Furthermore, using an optical fiber in Pauluth et al. as taught by Murphy et al. instead of a planar waveguide would provide a fiber channel holder."

Applicants respectfully disagree. Claims 8 and 36 are dependent on claim 1 and, therefore, incorporate all the limitations of claim 1 therein. Claim 1 has been amended to claim a flow cell comprising a substrate having at least one sample channel integral with at least one optical fiber channel holder. Each sample channel has a curved portion to deliver fluid to an isolated sensing area. The isolated sensing area is defined as an area where each optical fiber grating is in contact with the curved portion of each sample channel. Lastly, at least one sample port is positioned in an operable relationship to at least one sample channel. Pauluth et al. disclose a flow cell in Fig. 7 where the reflection grating coupler is equipped with a flow cell 29 with an inlet 30 and an outlet 31 for the gas to be analyzed. (Col. 7, lines 65-67 and Fig. 7). Pauluth et al. fail to disclose that the sample channel is curved to deliver fluid to an isolated sensing area. Nor do they disclose that the isolated sensing area is defined as an area where each optical fiber grating is proximate to a curved portion of each sample channel. Rather, the flow cell configuration of Pauluth et al. is such that there is perpendicular delivery of the sample to the waveguide. Moreover, Pauluth et al. fail to disclose that the waveguide is precisely aligned and tensioned in a straight line within an optical fiber channel holder. (Claim 1). Rather, the waveguide of Pauluth et al. is produced on a BGG36 glass slide (col. 5, line18) or on a glass substrate (see Example 3, col. 7, line 48 which refers to Fig. 7 and a grating coupler). Murphy et al. disclose an optical fiber long period sensor having a reactive coating. Were one of ordinary skill in the art to combine the optical waveguide of Murphy et al. in the flow cell of Pauluth et al., as the Examiner suggests, the limitations of claim 1 would not be met, nor would the invention be obvious. In particular, neither reference discloses a flow cell comprising a substrate having a curved sample channel that delivers the sample to an isolated sensing area. Nor does either

reference disclose that the optical fiber is precisely aligned and tensioned in a straight line within an optical fiber channel holder. In fact, were one of ordinary skill in the art to employ the optical fiber long period sensor of Murphy et al. in the flow cell of Pauluth et al., the optical fiber would be supported on a glass substrate and difficulty would be encountered because the sensor would not be precisely aligned and tensioned. Moreover, delivery of the sample to the sensing region would not occur by way of a curved portion of the sample channel as presently claimed. Furthermore, the Examiner admits to Pauluth et al. and Murphy et al. failing to teach a curved sample channel. Therefore, the present invention as claimed, would not be obvious based on the combination of Pauluth et al. with that of Murphy et al.

Claim 2 is rejected under 35 USC §103(a) as being unpatentable over Pauluth et al. and Murphy et al. as applied to claim 1, above, and further in view of Chervet (US Patent 5,057,216). The Examiner asserts that "Chervet teaches a curved flow cell provides no dead volume (see column 2, lines 53-61). Thus, it would have been obvious to one having ordinary skill in the art to use a curved sample channel in Pauluth et al. and Murphy et al. as taught by Chervet for optimum efficiency of the sensor by having no dead volume."

Applicants respectfully disagree. Chervet discloses "a capillary flow cell in which a capillary partially extends along the optical path of the cell and has two end portions bent to achieve an essentially Z-shaped configuration, and a template with a central bore in which the middle part of the capillary is positioned." (See col. 1, lines 33-38.) "The capillary consists of fused silica coated with polyimide. The middle portion of the capillary is not coated." (Col. 2, lines 8-10) The middle portion of the capillary defines the optical path of the flow cell. The two bends, 14, 15 constitute the entrance and exit window for the light beam." (Col. 2, lines 12-14). Applicants' invention, as claimed, can be distinguished. First, in applicants' claimed invention, the optical path is linear such that the entrance and exit window for the light beam is linear. This is accomplished because "each optical fiber channel holder has an optical fiber disposed

therein, wherein each optical fiber has at least one grating and wherein each optical fiber is precisely aligned and tensioned <u>in a straight line</u> within each optical fiber channel holder." (Claim 1.) Secondly, applicants' flow cell comprises a substrate having at least one sample channel integral with at least one optical fiber channel holder, wherein each sample channel has a curved portion <u>to deliver fluid</u> to an isolated sensing area. (Claim 1) The curved path in the flow cell of Chervet is an <u>optical path</u>, not a sample channel for delivery of a sample to an isolated sensing area. Furthermore, the isolated sensing area, as claimed by applicants, is defined as an area where each optical fiber grating is proximate to the curved portion of each sample channel. (Claim 1) Were one to combine the teachings of Pauluth et al., Murphy et al., and Chervet, one would obtain a flow cell having an optical fiber <u>bent</u> in a Z-shaped configuration, and a template with a central bore in which the middle part of the capillary is positioned. Moreover, there would be no sample channel having a curved portion to deliver fluid to an isolated sensing area. There would also be no optical fiber channel holder having an optical fiber disposed therein, wherein each optical fiber has at least one grating and wherein each optical fiber is precisely aligned and tensioned <u>in a straight line</u> within each optical fiber channel holder. (Claim 1) Therefore, the rejection is without basis and should be withdrawn.

Claims 5-7 and 9-13 stand as rejected based on Pauluth et al. The Examiner states that, "Pauluth et al. show two planar mating pieces of the substrate structure. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use a monolithic structure in Pauluth et al., since it has been held that forming in one piece an article which has formerly been formed in two pieces and put together involves only routine skill in the art. Since Pauluth et al.'s device comprises two mating pieces; the device would inherently be interchangeable." Claims 5-7 and 9-13 are dependent on claim 1 and, therefore, incorporate the limitations of claim 1 therein. The teaching of Pauluth et al. fails to render the presently claimed invention as obvious as Pauluth et al. fail to disclose a flow cell comprising a substrate having at least one sample channel integral with at least one optical fiber channel holder. Each sample channel has a

curved portion to deliver fluid to an isolated sensing area. Each optical fiber channel holder has an optical fiber disposed therein, wherein each optical fiber has at least one grating and wherein each optical fiber is precisely aligned and tensioned in a straight line within each optical fiber channel holder. The isolated sensing area is defined as an area where each optical fiber grating is proximate to the curved portion of each sample channel. Lastly, at least one sample port is positioned in an operable relationship to at least one sample channel. (Claim 1) In particular, Pauluth et al. fail to disclose, nor would it be obvious based on their teaching, that the flow cell has an optical fiber channel holder with an optical fiber disposed therein, wherein each optical fiber has at least one grating and wherein each optical fiber is precisely aligned and tensioned in a straight line within each optical fiber channel holder. It is the precise alignment and tensioning achieved by the optical fiber channel holder that allows for the reduction of optical distortions and simplifies fabrication procedures such that the configuration of the sample channel is not disturbed. (See paragraph 0037.) Moreover, Pauluth et al. fail to disclose nor would it be obvious to introduce a sample into an isolated sample section through a curved portion of the sample chamber. Therefore, the rejection is without basis and should be withdrawn.

Claims 14-24 stand as rejected. The Examiner asserts that "even though Pauluth et al. and Murphy et al. only show one of each inlet, outlet and sample channel, it would have been obvious to one having ordinary skill in the art at the time the invention was made to apply any number of inlet, outlet and sample channels, since it has been held that mere duplication of the essential working parts of a device involves only routine skill in the art." Claims 14-24 are dependent on claim 1 and, therefore, incorporate the limitations of claim 1 therein. Applicants have argued the differences between Pauluth et al. and Murphy et al. above. In particular, by combining the teachings of Pauluth et al. with that of Murphy et al. one would not arrive at a flow cell as claimed in instant claim 1. Rather, the optical fiber of Murphy et al. would be mounted on a glass slide and not tensioned and aligned within an optical fiber channel holder. The sample channel would

not be curved such that an isolated sensing area is formed. The Examiner has admitted that the combination of Pauluth et al. and Murphy et al. fail to teach a curved sample channel. Therefore, the rejection is without basis and should be withdrawn.

Claims 25 and 26 stand as rejected. The Examiner states, "a standard microtiter plate has 9mm spacing, thus having 9mm spacing between sample channels would have been obvious in Pauluth et al. and Murphy et al. Claims 25 and 26 are dependent on claim 1 and incorporate the limitations of claim 1 therein. For the reasons stated above, the invention as now claimed would not be obvious based on the teachings of Pauluth et al. and Murphy et al. because the combination of art cited fails to disclose a flow cell comprises a substrate having at least one sample channel integral with at least one optical fiber channel holder. Each sample channel has a curved portion to deliver fluid to an isolated sensing area. Each optical fiber channel holder has an optical fiber disposed therein, wherein each optical fiber has at least one grating and wherein each optical fiber is precisely aligned and tensioned in a straight line within each optical fiber channel holder. The isolated sensing area is defined as an area where each optical fiber grating is proximate to the curved portion of each sample channel. Lastly, at least one sample port is positioned in an operable relationship to at least one sample channel. The Examiner has admitted that the teachings of Pauluth et al. and Murphy et al. fail to teach a curved sample channel. Therefore, the rejection is without basis and should be withdrawn.

Claims 27-35 stand as rejected. The Examiner asserts that "controlled delivery of the sample using various ways into the flow cell would have been obvious to one having ordinary skill in the art at the time the invention was made in order for the user to control the test for different applications." Applicants respectfully disagree. Claims 27-35 are dependent on claim 1 and, therefore, incorporate all the limitations of claim 1 therein. Therefore, for the reasons stated above, the rejection is without basis and should be withdrawn.

Claims 37-42 stand as rejected. The Examiner asserts that "even though Pauluth et al. and Murphy et al. (Murphy et al. teach using a long period grating) do not teach that the grating is a Bragg grating. Bragg gratings are one of well known type of gratings that are used in the art and thus would have been obvious to one having ordinary skill in the art at the time the invention was made to use any other well gratings including Bragg gratings (since applicant does not provide the criticality of having any particular grating) in Pauluth et al. and Murphy et al. as long as the grating detects the sampled being tested." Applicants respectfully disagree. Claims 37-42 are dependent on claim 1 and, therefore, incorporate all the limitations of claim 1 therein. The Examiner has admitted that the teaching of Pauluth et al. and Murphy et al. fail to teach a curved sample channel. Therefore, for the reasons stated above, the rejection is without basis and should be withdrawn.

Claims 51 and 52 stand as rejected. The Examiner asserts that "since Pauluth et al. and Murphy et al. show two mating pieces that are put together to make a flow cell, one with ordinary skill in the art would recognize having means to connect all mating pieces together in Pauluth et al. and Murphy et al. in order to hold the pieces together." Applicants respectfully disagree. Claim 51 is directed toward a flow cell kit comprising an upper substrate having at least one curved sample channel for delivering a sample to an isolated sensing area and at least one sample port disposed therein; at least one optical fiber channel holder having an optical fiber disposed therein wherein each optical fiber has at least one grating disposed therein wherein each optical fiber is precisely aligned and tensioned in a straight line within each optical fiber channel holder; wherein the optical fiber channel holder has a means to connect to the upper substrate to form a unit wherein the isolated sensing area is defined as an area where the grating is proximate to the curved portion of the sample channel; and a lower substrate having a means to connect to the optical fiber channel holder on a side opposite from the upper substrate. Claim 52 is dependent on claim 51 and, therefore, incorporates the limitations of claim 51 therein. Neither Pauluth et al. nor Murphy et al. disclose the flow cell as claimed. In

fact, the Examiner has admitted that neither reference discloses a curved sample channel for delivering a sample to an isolated sensing area. Moreover, neither reference discloses an optical fiber channel holder having a means to connect to an upper substrate to form a unit wherein an isolated sensing area is defined as an area where the grating is proximate to the curved portion of the sample channel. In addition, there is no teaching of assembling a plurality of units together to form an array. Therefore, the rejection is without basis and should be withdrawn.

CONCLUSION

In view of the above Amendments and Remarks, it is submitted that claims 1, 3-42, and 51-53 are in condition for allowance. Reconsideration and withdrawal of the rejections are requested and allowance of the claims at an early date is solicited.

Respectfully submitted,

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